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(71) Applicant(s)
Rover Group Limited
(Incorporated in the United Kingdom)
International Headquarters,
Warwick Technology Park, WARWICK, CV34 6RG,
United Kingdom

(72) Inventor(s)
Christopher John Shakespeare

(74) Agent and/or Address for Service
O R T Davies
Rover Group Limited, Gaydon Test Centre,
Banbury Road, LIGHTHORNE, Warwick, CV35 0RG,
United Kingdom

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(54) Abstract Title
Electrical relay incorporating ptc element

(57) An electrical relay 10 comprises a coil 16 wound around an iron core 14 which in use produces a magnetic field when a electric current is passed therethrough. The magnetic field may influence the movement of an armature 20 which may pivot about a fulcrum 22 at the upper end of a yoke 24. The armature is biased by a spring 26 into a position in which the contacts are normally open. Upon magnetisation of the coil, the armature 20 closes the contacts 18 and provides a load line through the relay 10. A positive temperature coefficient element (PTC) 28 which may be of polymer material is integrated with a connection member LP1 of the relay 10, said connection members allowing connections to made between the coil 16 and switching portions 18 and external circuits. The relay may take the form of a change over relay (see fig. 2) in which the armature can open / close contacts with two different load lines. The positioning of the PTC element can determine which load lines are provided with over-current protection.

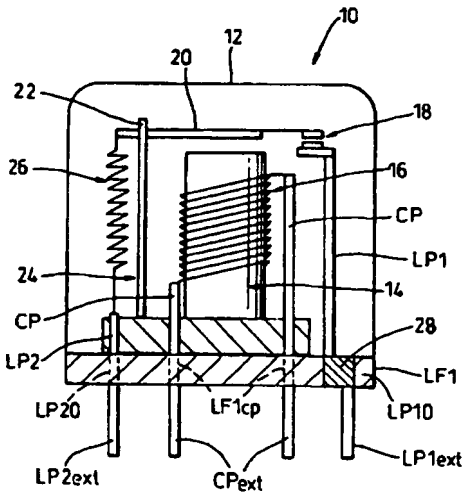

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

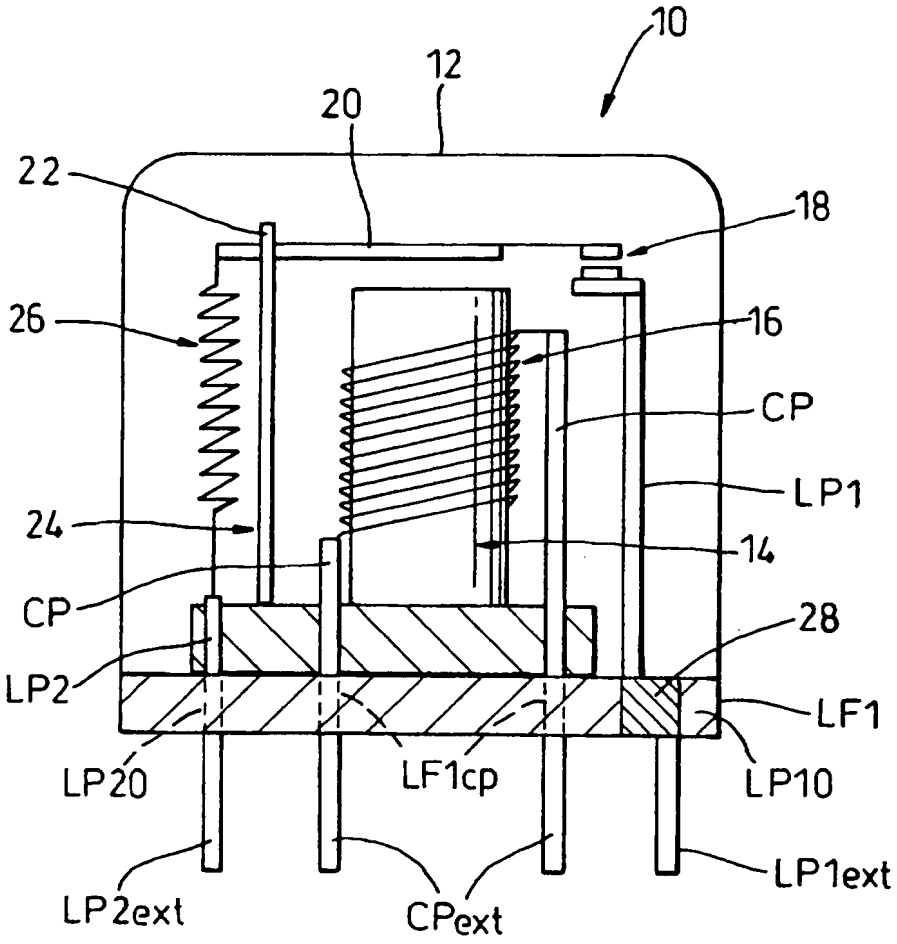

Fig. 1

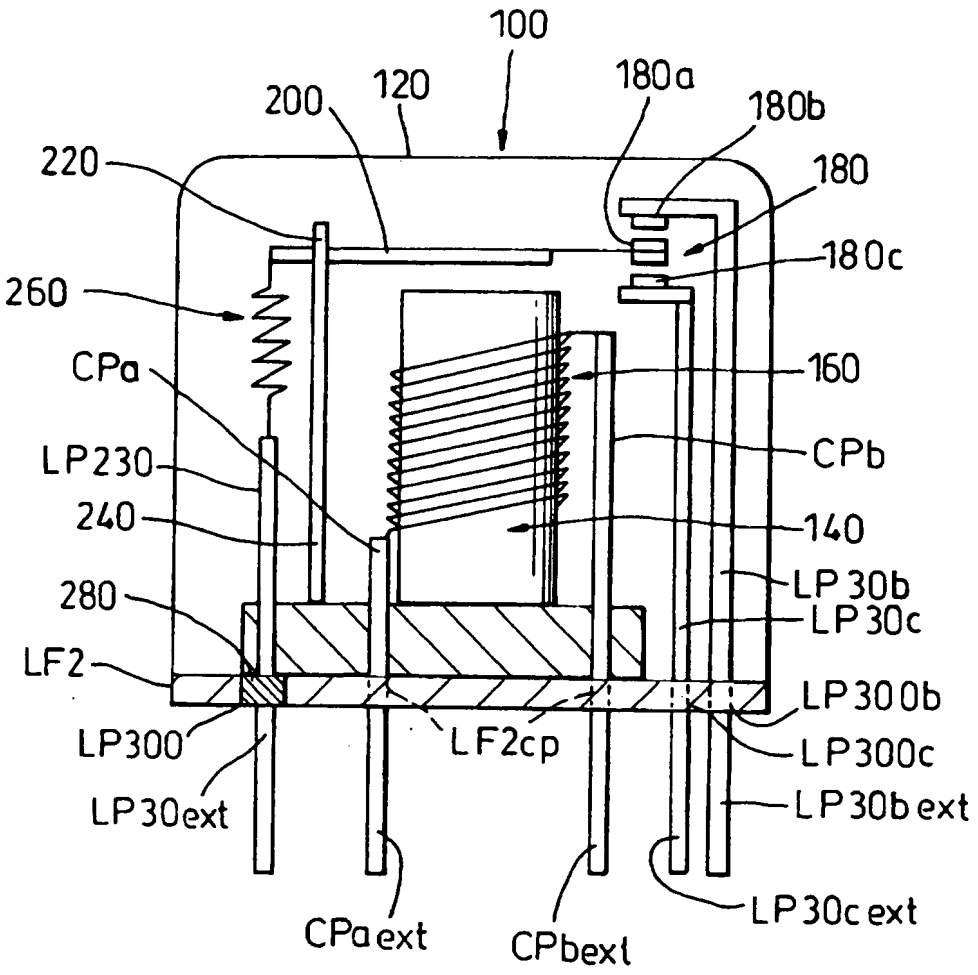

Fig. 2

An Electrical Relay

This invention relates to electrical relays an in particular to a relay which includes means for thermal protection.

It is a disadvantage of some known electrical relays that it is advisable to protect the relay and/or the load driven by such a relay by including an in-line fuse. The provision of an additional circuit element incurs increased manufacturing costs and may be subject to packaging constraints.

It is an object of this invention to provide an improved electrical relay.

According to the invention there is provided an electrical relay comprising a coil portion which is arranged in use to produce a magnetic field when an electrical current is passed therethrough and a switching portion which is arranged in use, in response to said magnetic field, to control the passage of a load current through a load line of the relay, the relay also comprising a plurality of external connection members which are arranged to allow a connection to be made from each of the coil portion and the switching portion to an external circuit, the relay further comprising a lead frame which is integral to the relay and which is arranged to provide a said connection between a said external connection member and an associated one end of the coil portion or the switching portion, wherein a positive temperature coefficient element is included in said connection

between said external connection member and the associated coil end or switching portion.

The positive temperature coefficient element may be included by at least one of, or a combination of, a pressure connection and a solder connection.

The relay may comprise a further positive temperature coefficient element, which is integrated with another external connection member or with an internal connection member.

The positive temperature coefficient element may comprise a polymer material and may comprise a wafer construction.

The relay may comprise an International Standards Organisation (ISO) relay footprint, whereby the relay may be arranged to be backward compatible so that it can be retro-fitted to a circuit as a replacement for an originally fitted relay and/or to provide a thermal fuse for a circuit which may not have originally been provided with over-current protection.

The relay may comprise a normally open relay. In the alternative, the relay may comprise a change-over relay. and a positive temperature coefficient element may be included in series with a said connection on the

common side of a set of load contacts which comprise a change-over portion of the relay.

A positive temperature coefficient element may be included in series with a said connection which is in series with a load contact on the non-common side of the relay.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a section through an electrical relay according to a first embodiment of the invention: and

Figure 2 is a section through a relay according to a second embodiment of the invention.

Referring to Figure 1. in a first embodiment of the invention an electrical relay 10 comprises a housing 12 in which are contained a coil portion and a switching portion.

The coil portion comprises a soft iron core 14 around which is wound a coil 16. Each end of the coil 16 is connected to an internal connection member in the form of a coil pin CP which allows the coil 16 to be connected to an electrical circuit (not shown) which is external to the relay 10.

The relay 10 includes an integral lead frame LF1, through which the coil pins CP, and therefore the coil 16, are interfaced to external connection members CPext via respective lead frame connections LF1cp.

The switching portion comprises pair of contacts 18, one of which is mounted on an internal connection member in the form of a first load pin LP1 and the other of which is mounted on a movable armature 20. The armature 20 is movable by a pivoting action about a fulcrum 22 in the region of the upper end of a yoke 24. The armature 20 is biased by a spring 26 into a position in which the contacts 18 are normally open, the spring 26 also providing an electrical connection between the end portion of the armature 20 opposite to the contacts 18 and a second load pin LP2 which forms, in combination with the first load pin LP1, a load line through the relay 10.

In similar fashion to the coil pins CP, the load pins LP1, LP2 are connected to external connection members LP1ext, LP2ext through the lead frame LF1 by respective connections LP10, LP20.

When an electrical current, the coil current, is passed through the coil 16, the core 14 becomes magnetised and pulls the armature 20 down in a solenoid type of action, thereby closing the contacts 18 and providing a load

line between the load pins LP1, LP2 and allowing a load current to flow through the relay 10.

When the coil current is switched off, the core 14 becomes demagnetised and the biasing of the spring 26 pivots the armature 20 about the yoke 24, which in turn causes the contacts 18 to open and cut off the passage of any load current.

A positive temperature coefficient element (PTC) 28 is included in the lead frame LF1 and is integrated into the connection LP10 between the first load pin LP1 and its external connection LP1ext and the PTC 28 is thus put in series with the path of any load current. In a variation to the invention, the PTC 28 could be integrated into the lead frame connection LP20 between the other load pin LP2 and its external connection LP2ext, whilst still protecting the relay 10 from any excessive load current.

The PTC 28 comprises a polymer material, is of wafer construction and is integrated into the connection LP10 by soldering. The PTC 28 could also be integrated by pressure (e.g. a crimped connection) or by a combination of pressure and soldering.

The PTC 28 has a characteristic curve which is chosen to be appropriate for the load currents that the relay 10 is likely to have to pass. At a

specified level of over-current, the resistance of the PTC 28 will rise to a level (e.g. to several kΩ or more) where it acts as a thermal fuse and cuts off the load current. On cooling over time, the resistance of the PTC 28 will drop to a level (e.g. a few hundred mΩ) at which the load current may once again flow along the load line.

Referring now to Figure 2, in a second embodiment of the invention an electrical change-over relay 100 comprises a housing 120 in which are contained a coil portion and a switching portion.

The coil portion comprises a soft iron core 140 around which is wound a coil 160. Each end of the coil 160 is connected to an internal connection member in the form of a coil pin CPa, CPb which allows the coil 160 to be connected to an electrical circuit (not shown) which is external to the relay 100.

The relay includes an integral lead frame LF2, through which the coil pins CPa, CPb, and therefore the coil 160, are interfaced to external connection members CPaext, CPbext via respective lead frame connections LF2cp.

The switching portion comprises a set of change-over contacts 180, which are sub-divided into a switching contact 180a, a first load contact

180b and a second load contact 180c. The first load contact 180b is connected to an internal connection member in the form of a first load pin LP30b and the second load contact 180c is connected to an internal connection member in the form of a second load pin LP30c.

The switching contact 180a is mounted on a movable armature 200, which is movable by a pivoting action about a fulcrum 220 in the region of the upper end of a yoke 240. The armature 200 is biased by a spring 260 into a position in which the switching contact 180a is normally in contact with the first load contact 180b, the spring 260 also providing an electrical connection between the end portion of the armature 200 opposite to the contacts 180 and an internal connection member in the form of a third load pin LP30 which forms, in combination with which ever of the other load pins LP30b, LP30c is in contact with the switching contact 180a, a load line through the relay 100.

When an electrical current, the coil current, is passed through the coil 160, the core 140 becomes magnetised and pulls the armature 200 down in a solenoid type of action, thereby changing over the load line at the contacts 180 by moving the switching contact 180a out of contact with the first load contact 180b and into contact with the second load contact 180c and thus providing a load line between the load third load pin LP30 and the second load pin LP30c.

When the coil current is switched off, the core 140 becomes demagnetised and the biasing of the spring 260 pivots the armature 200 about the fulcrum 220, which in turn causes the switching contact 180a to move out of contact with the second load pin LP30c and back into contact with the first load pin LP30b.

In similar fashion to the coil pins CPa, CPb, the load pins LP30b, LP30c are connected to respective external connection members LP30bext, LP30cext and the third load pin LP30 to its own external connection member LP30ext. These respective connections LP300b, LP300c, LP300 are made in the lead frame LF2.

A positive temperature coefficient element (PTC) 280 is included in the lead frame LF2 and is integrated into the connection LP300 between the third load pin LP30 and its external connection LP30ext.

The PTC 280 comprises a polymer material, is of wafer construction and is integrated into the connection LP300 by soldering. The PTC 280 could also be integrated by pressure (e.g. a crimped connection) or by a combination of pressure and soldering.

The PTC 280 has a characteristic curve which is chosen to be appropriate for the load currents that the relay 100 is likely to have to pass.

At a specified level of over-current, the resistance of the PTC 280 will rise to a level (e.g. to several kΩ or more) where it acts as a thermal fuse and cuts off the load current. On cooling over time, the resistance of the PTC 280 will drop to a level (e.g. a few hundred mΩ) at which the load current may once again flow along the load line.

In this example of the invention, the advantage of integrating the PTC 280 into the connection LP300 is that in that way both of the other load pins LP30b, LP30c are provided with over-current protection by a single PTC 280.

In a variation to the second embodiment, a PTC (not shown) could, in addition or in the alternative, be included in either or both of the first and second load pins LP30b, LP30c. In this manner, the relay 100 could be provided with independent over-current protection for each load served by the change-over between the first and second load pins LP30b, LP30c. An advantage offered by this variation of the second embodiment is that PTCs with different characteristics could be fitted to the load pins LP30b, LP30c when they LP30b, LP30c were used to provide a load line to loads drawing different currents.

In a possible modification to the embodiments described above, a further PTC (not shown) may, in the alternative or in addition, be

integrated into one or both of the coil pin lead frame connections LF1cp, LF2cp. In this manner it is possible to integrate one or more PTCs in series with either or both of the coil current and the load current on either side of the coil portion or the switching portion as appropriate and protect the circuit.

In each embodiment, it is desirable for a relay 10, 100 which includes an integrated PTC element 28, 280 to retain a standard footprint, for example the International Standards Organisation (ISO) footprint. This allows a relay according to the invention to be backward compatible such that it could therefore be retro-fitted to a circuit which was originally produced using a relay with no thermal protection or so as to introduce thermal fusing.

CLAIMS

1. An electrical relay comprising a coil portion which is arranged in use to produce a magnetic field when an electrical current is passed therethrough and a switching portion which is arranged in use, in response to said magnetic field, to control the passage of a load current through a load line of the relay, the relay also comprising a plurality of external connection members which are arranged to allow a connection to be made from each of the coil portion and the switching portion to an external circuit, the relay further comprising a lead frame which is integral to the relay and which is arranged to provide a said connection between a said external connection member and an associated one end of the coil portion or the switching portion, wherein a positive temperature coefficient element is included in said connection between said external connection member and the associated coil end or switching portion.

2. A relay according to Claim 1, wherein the positive temperature coefficient element is included by at least one of, or a combination of, a pressure connection and a solder connection.

3. A relay according to Claim 1 or Claim 2, comprising a further positive temperature coefficient element, which is integrated with

another external connection member or with an internal connection member.

4. A relay according to any preceding claim, the positive temperature coefficient element comprising a polymer material.

5. A relay according to any preceding claim, the positive temperature coefficient element comprising a wafer construction.

6. A relay according to any preceding claim, wherein the relay comprises an International Standards Organisation (ISO) relay footprint, whereby the relay may be arranged to be backward compatible so that it can be retro-fitted to a circuit as a replacement for an originally fitted relay and/or to provide a thermal fuse for a circuit which may not have originally been provided with over-current protection.

7. A relay according to any preceding claim, comprising a normally open relay.

8. A relay according to any one of Claims 1 to 6, comprising a change-over relay.

9. A relay according to Claim 8, wherein a positive temperature coefficient element is included in series with a said connection on the common side of a set of load contacts which comprise a change-over portion of the relay.

10. A relay according to Claim 8 or Claim 9, wherein a positive temperature coefficient element is included in series with a said connection which is in series with a load contact on the non-common side of the relay.

11. An electrical relay substantially as described herein with reference to Figure 1 or with reference to Figure 2 of the accompanying drawings.

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Application No:	GB 9921772.1	**Examiner:**	Vaughan Phillips
Claims searched:	1-11	**Date of search:**	2 December 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H1N

Int Cl (Ed.6): H01H

Other: Online: WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	CA 2019925 A1	(STAPLES) see PTC element 16 in series with contacts 28, 52 and terminal 18; and external connection members 18, 48, 50	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.